SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-12a

AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/8815		
Aircraft Registration	**ZS-RRM**	**Date of Accident**	29 July 2010		**Time of Accident**	1000Z	
Type of Aircraft	Robinson R22 Beta (Helicopter)		**Type Operation**		Hire an Fly		
Pilot-in-command Licence Type	Private Pilot		**Age**	47	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		381,3		Hours on Type	89,4	
Last point of departure	Rand Aerodrome (FAGM), Gauteng Province						
Next point of intended landing	Rand Aerodrome (FAGM), Gauteng Province						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
5 nautical miles south of Panorama at GPS co-ordinates S26˚23.680 E028˚03.429							
Meteorological Information	Wind direction: light/variable; Temperature: 19˚C; Visibility: good.						
Number of people on board	1 + 0	**No. of people injured**	0	**No. of people killed**	0		

Synopsis

The pilot was on a private flight in the FAGM general flying area. During a stable hover approximately 10 ft above the ground, he decided out of curiosity to test the effect on the helicopter's overall performance of changing the rotor and engine RPM. Under normal circumstances, the governor system will control the RPM – unless it is switched off or defective. The investigation determined that the governor system was not defective but switched off. Due to the pilot's failure to co-ordinate throttle input and collective pitch properly, a rotor and engine over-speed problem occurred. Focused on the instrument panel, the pilot lost situational awareness and failed to observe that the helicopter was banking and sinking. The right skid struck the ground and the aircraft experienced a dynamic rollover. The helicopter was substantially damaged but the pilot did not suffer any injury.

According to the Owner and Flight Training Centre, the pilot indicated that he had attempted to fly with the governor off. The resultant lag and increased response of the throttle movement obviously caused the pilot to freeze and he employed the incorrect recovery technique. The helicopter subsequently rolled over and was substantially damaged.

Probable Cause

Loss of control

Contributing Factor: The corrective action by the pilot would have been to manually control the RPM first and then engage the governor, once stabilised. The onset of, and subsequent uncontrolled RPM profile obviously alarmed the pilot and lead to the unfortunate incident

IARC Date		Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner/Operator : Henley Air (Pty) Ltd
Manufacturer : Robinson Helicopter Company
Model : R22 Beta
Nationality : South African
Registration Marks : ZS-RRM
Place : General Flying Area at GPS co-ordinates S26˚23.680 E028˚03.429
Date : 29 July 2010
Time : 1000Z

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (1997), this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to establish legal liability****.*

Disclaimer

This report is given without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 The pilot flew the helicopter from Rand Aerodrome (FAGM) to the general flying area (GFA) on a private flight. He reported that during a stable hover in the GFA, he decided out of curiosity to test the effect of rotor and engine RPM on performance. He closed the throttle fractionally and then immediately opened it fractionally. This caused the rotor and engine RPM to respond instantly, something he did not expect, and the tachometer reading showed the rotor and engine RPM increasing rapidly above the green arc range. The pilot attempted to bring the RPM indication back into the green arc, but was unsuccessful. Throughout this time, he remained focused on the instrument panel and lost situational awareness. The helicopter started to bank slowly to the right in a nose-down attitude. The right skid struck the ground and the aircraft dynamically rolled over onto its right side, sustaining substantial damage. The pilot was not injured in the accident.

1.1.2 The pilot indicated that he had attempted to fly with the governor off. The resultant lag and increased response of the throttle movement obviously caused the pilot to freeze and he employed the incorrect recovery technique. The helicopter subsequently rolled over and was substantially damaged

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	1	-	-	-

1.3 Damage to Aircraft

1.3.1 The helicopter was extensively damaged.

Figure 1. View of the wreckage on level ground.

1.4 Other Damage

1.4.1 None.

1.5 Personnel Information

Nationality	South African	Gender	Male	Age	47
Licence Number	0271009961	Licence Type	Private Pilot		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Flight Tests – Single-engine Piston				
Medical Expiry Date	31 August 2010				
Restrictions	None				
Previous Accidents	None				

Flying Experience

Total Hours	381,3
Total Past 90 Days	17,5
Total on Type Past 90 Days	2,6
Total on Type	89,4

1.6 Aircraft Information

Airframe

Type	Robinson R22 Beta	
Serial Number	3481	
Manufacturer	Robinson Helicopter Company	
Year of Manufacture	2003	
Total Airframe Hours (at time of accident)	3 750,3	
Last MPI (Date & Hours)	20 July 2010	3 720,2
Hours since Last MPI	30,1	
C of A (Issue Date)	18 September 2003	
C of R (Issue Date) (Present Owner)	12 September 2003	
Operating Categories	Standard – Part 127	

Engine

Type	Lycoming O-360-J2A
Serial Number	L-39202-36A
Hours since New	3 557,8
Hours since Overhaul	527,0

1.6.1 The pilot carried out a preflight inspection prior to the accident flight, during which he checked the general condition and maintenance records to ensure that the helicopter was airworthy.

(i) The helicopter was found in a serviceable condition.
(ii) The documentation was valid and maintenance records were certified appropriately in accordance with applicable regulations.
(iii) No deferred defect or malfunction was recorded in the flight folio.

1.6.2 The helicopter had sufficient fuel for the flight, and weight and balance were found to be within the specified limits.

1.7 Meteorological Information

1.7.1 The weather information below was obtained from the pilot's questionnaire.

Wind direction	Variable	Wind speed	Light	Visibility	Good
Temperature	19°C	Cloud cover	CAVOK	Cloud base	CAVOK
Dew point	Unknown				

1.8 Aids to Navigation

1.8.1 The helicopter was fitted with standard navigation equipment approved for the type. Additional navigation equipment, approved by SACAA, was also installed to the helicopter. The equipment was serviceable and there was no report of any defects or malfunctioning during the flight.

1.9 Communications

1.9.1 The pilot flew the helicopter in the GFA and broadcast his intentions on VHF frequency 124.4 MHz

1.9.2 The helicopter was fitted with VHF radio equipment. This was serviceable and there was no report of a defect or malfunction experienced in flight with it.

1.10 Aerodrome Information

1.10.1 The accident took place on an open field within the GFA of Rand Aerodrome.

1.11 Flight Recorders

1.11.1 There was no flight data recorder installed, neither was it required by regulations.

1.12 Wreckage and Impact Information

1.12.1 The helicopter was in a hover and banked to the right. The right skid struck the ground and the helicopter dynamically rolled over onto its right side. The main rotor blades struck the ground and the aircraft sustained substantial damage during the impact sequence.

Figure 2: Helicopter viewed at rear section

1.13 Medical and Pathological Information

1.13.1 The pilot had a valid Class 2 aviation medical certificate with no waivers. There was no medical condition which might have prevented the pilot from flying the helicopter on the day.

1.14 Fire

1.14.1 There was no evidence of pre- or post-impact fire.

1.15 Survival Aspects

1.15.1 The accident was survivable although the helicopter rolled onto its right-hand side with the pilot occupying the right-hand seat. The fact that he was properly restrained with safety belt and harnesses, he sustained no injuries. The cabin however, remained intact after the helicopter struck the ground.

1.15.2 The accident site was not near an aerodrome. No emergency services were dispatched to the scene. A helicopter from Rand aerodrome was dispatched to the site to render assistance to the pilot if required.

1.16 Tests and Research

1.16.1 Excerpt from the FAA Rotorcraft Flying Handbook:

As the collective pitch control lever is raised or lowered, it changes the pitch angle of all main rotor blades simultaneously. An adjustable friction control helps to prevent inadvertent collective pitch movement. As the pitch angle increases, angle of attack increases, drag increases and rotor RPM decreases. As the pitch angle decreases both angle of attack and drag decreases, while rotor RPM increases. A

proportionate change in power is required, thus to achieve correct power setting the throttle control is used which in effect regulates the engine RPM. If the governor is not installed or switched on, the throttle will be moved manually by twist grip in order to maintain RPM. Twisting the throttle outboard increases RPM; twisting it inboard decreases RPM.

Figure 3. The collective pitch lever and throttle control lever.

1.16.2 *Factors affecting performance:*

A helicopter's performance is dependent on the power output of the engine and the lift production of the rotors, whether it is the main rotor or tail rotor. Any factor that affects engine and rotor efficiency affects the performance.

1.16.3 Excerpt from Robinson Helicopters R22 Beta, Approved Flight Manual, Section 2 "Limitations":

Rotor Tachometer Reading		**Engine Tachometer Reading**	
Upper Red Line	110%		
Yellow Arc	104% to 110%	**Upper Red Arc**	104% to 110%
Green Arc	101% to 104%	**Green Arc**	101% to 104%
Yellow Arc	90% to 101%	**Lower Red Arc**	90% to 101%
Lower Red Line	90%		
Yellow Arc	60% to 70%	**Yellow Arc**	60% to 70%

Note: Limitations for both rotor and engine speed indicated by installed tachometer are not to be exceeded.

Figure 4. The instrument panel of ZS-RRM, showing the tachometer measuring rotor and engine RPM.

1.16.4 Excerpt from Robinson Helicopters R22 Beta, Approved Flight Manual, Section 1 "General":

The pilot in command is responsible for determining that the aircraft is safe for flight. The pilot is also responsible for remaining within the operating limitations as outlined by instrument markings, placards, and this handbook. Since it is very difficult to refer to a handbook while flying a helicopter, the pilot should study the entire handbook and became very familiar with the limitations, performance, procedures and operational handling characteristics of the helicopter before flight.

1.16.5 The AFM further states that the governor should be allowed to control the RPM (provided that the governor is switched on) and the pilot should land as soon as possible. Hence, according to the takeoff procedure, the requirement is that the pilot should "verify governor on, RPM stabilise at 102 to 104 %".

The governor maintains engine RPM by sensing changes and applying corrective throttle inputs through a friction clutch which can be easily overridden by the pilot. The governor is only active above 80% engine RPM and can be switched on or off using the toggle switch on the end of the right seat collective. The governor is designed to assist in controlling RPM under normal conditions.

***Note**: Flight is prohibited with governor selected off, with exceptions for in-flight system malfunction or emergency procedure training".*

Figure 5. The position of the governor toggle switch.

1.16.6 Dynamic rollover

This occurs when a helicopter pivots around its skid or wheel, and rolls over. If the pilot does not use proper corrective techniques, the roll action cannot be stopped. The main rotor thrust and moment then follows the helicopter as it continues to roll over until it impact the ground.

1.17 Organisational and Management Information

1.17.3 The pilot was flying the helicopter under a “hire-and-fly” agreement.

1.18 Additional Information

1.18.1 The governor:
According to Owner and Flight Training Centre the pilot indicated that he had attempted to fly with the governor off. The resultant lag and increased response of the throttle movement obviously caused the pilot to freeze and he employed the incorrect recovery technique. The helicopter subsequently rolled over and was substantially damaged.

1.18.2 The corrective action by the pilot would have been to manually control the RPM first and then engage the governor, once stabilised. The onset of, and subsequent uncontrolled RPM profile obviously alarmed the pilot and lead to the unfortunate incident

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1 The pilot had a valid licence with the type rating endorsed on it, as well as a valid aviation medical certificate with no waivers. He had no medical condition which might have prevented him from performing the flight on the day. He was the sole occupant of the helicopter and flew it on a private flight, the purpose of which was to increase his flying experience and remain current on the type.

2.2 The pilot was flying the helicopter in the Rand Aerodrome GFA at the time of the accident. The flight was uneventful until the accident took place. The helicopter's performance was within the required limitations in accordance with the operational requirements. While in a stable hover, the pilot decided out of curiosity to test the effect on the helicopter's overall performance of changing the rotor and engine RPM. He closed the throttle to decrease power and immediately opened it again.

2.3 The rotor and engine RPM responded instantly, as indicated by the needles entering the yellow or red arcs on the tachometer. The pilot tried to recover when he saw what was happening but this recovery did not take place instantaneously.

2.4 According to the aircraft flight manual, the helicopter governor should be allowed to control the rotor and engine RPM, but it can only function if it is switched on. Flight is actually prohibited with the governor selected off with the exception of an in-flight system malfunction or emergency procedure training. The pilot performed a preflight inspection and one of the requirements was for him to ensure that the governor was switched on. He did not report any defect or system malfunction during the flight or after the accident occurred. The evidence also shows that he did not experience a flight system malfunction or perform emergency procedure training. The investigation determined that the governor and all related components in the system were serviceable during the flight until the time the accident occurred.

2.5 According to the pilot, he was surprised by the responsiveness of the rotor and engine RPM indication on the tachometer. The pointers were increasing from the green arc, which means that the rotor and engine RPM indication was too aggressive. Under normal circumstances, the governor should have controlled the RPM. The responsiveness of the tachometer indication showed that the governor was either switched off or malfunctioning.

2.6 The attention of the pilot was fixated on the rotor and engine RPM tachometer, and for several seconds he lost situational awareness and concentration. As a result, he failed to correct the helicopter's slow bank to the right and loss of altitude. The right skid then struck the ground, and formed a pivot point around which the helicopter's rolling moment started. The pilot was unable to correct the situation due to the nature of a dynamic rollover, and the helicopter toppled onto its side.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot had a valid private pilot's licence (PPL) and Class 2 aviation medical certificate.

3.1.2 The pilot flew the helicopter under visual flight rules (VFR) by day in the general flying (GF) area under a hire-and-fly agreement.

3.1.3 All the aircraft documentation that was required to be carried on board the helicopter was valid.

3.1.4 The pilot disregarded standard operating procedures.

3.1.5 The pilot's curiosity led him to make an unapproved throttle input during a hover.

3.1.6 The pilot failed to coordinate the throttle input and collective pitch properly, which resulted in rotor and/or engine over-speed.

3.1.7 The pilot failed to maintain a safe constant height due to a lack of situational awareness.

3.1.8 The pilot failed to maintain directional control during the hover.

3.1.9 The aircraft was hovering approximately 10 feet above the ground when it started to bank to the right and sink. The right skid struck the ground and the aircraft went into a dynamic rollover.

3.1.10 The helicopter sustained substantial damage in the accident.

3.1.11 The pilot did not suffer any injury in the accident.

3.1.12 The pilot reported that he did not experience any defect or malfunction with any of the aircraft systems, including the governor, during the flight.

3.1.13 The governor system is designed to assist in controlling RPM, hence preventing the responsiveness observed on the tachometer. The pilot obviously switched the governor off and attempted to fly with the governor off. The resultant lag and increased response of the throttle movement obviously caused the pilot to freeze and he employed the incorrect recovery technique.

3.2 Probable Cause/s

3.2.1 Loss of control
Contributory factors:

(i) Poor airmanship
(ii) Disregard for standard operating procedures 7.20 & 7.4
(iii) Pilot-induced accident

4. SAFETY RECOMMENDATIONS

4.1 None.

5. APPENDICES

5.1 None.

Compiled by:

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